

Wear-indicating filament

The invention relates to a wear-indicating filament for use in a brush, comprising a central axis, a core extending along the central axis, said core being covered by a layer having a pre-determined resistance to wear, said layer wearing away over a pre-determined period of use dependent on its resistance to wear and exposing at least a part
5 of the core after said period.

The invention further relates to a brush comprising a plurality of wear-indicating filaments each comprising a central axis, a core extending along the central axis, said core being covered by a layer having a pre-determined resistance to wear, said layer wearing away over a pre-determined period of use dependent on its resistance to wear and
10 exposing at least a part of the core after said period.

A filament of the type defined in the opening paragraph is known from GB 2323026. The known filament is comprised in the brush of a toothbrush and comprises a
15 core made of a material of one color, covered by a layer of a biodegradable polymer material of another color. The core is made of a polyamide type which absorbs relatively little water when the material is in contact with water. When the filaments are used with a cleaning agent such as toothpaste, the layer disintegrates and mechanically wears off over a controlled period of time, exposing the core of a different color. The exposure of the core is an
20 indication for the user that the brush has to be replaced by a new one.

A disadvantage of the known filament is that the user may continue to use the brush after the indication to replace the brush by exposure of the core. In this manner the user is using a brush which is becoming more and more soiled with bacteria and remainders over time, which exposes the user to a hygienic risk.
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It is an object of the invention to provide a wear-indicating filament for use in a brush which gives a clear indication that the brush should be replaced and which reduces the risk of the user continuing to use the brush after this indication has been given.

To achieve this object, a wear-indicating element according to the invention is characterized in that the layer comprises a material which absorbs relatively little water and the core comprises, seen in a cross-section, at least two segments in an asymmetrical arrangement along the central axis of the filament, which segments have a mutually different absorption of water and show a difference in expansion when the layer has worn and the core is exposed to water. The layer which covers the core absorbs almost no water during use and thus ensures proper functioning of the brush. After a certain period of use this layer is worn away, which causes the core to be exposed to water during use. When the at least two segments of the cross-section of the filament become exposed to water, the segments show a difference in absorption of water and a difference in expansion resulting from this absorption. The difference in absorption may be the speed with which water is absorbed or the amount to which it is absorbed. The difference in expansion causes the filament to bend away laterally from its central axis, which will be seen by the user and felt during use of the brush on the teeth. This provides a clear indication that the brush should be replaced, because the bent filaments give a warning to the user in a visual manner and in a tactile manner.

It is advantageous when a first segment comprises a polyamide chosen from a group comprising PA-6, PA-6.6. These materials are suitable for forming one of the segments within the core, because PA-6 has a relatively high maximum water absorption of 10%, and PA-6.6 of 8,5%, and both materials expand relatively quickly when they are exposed to water.

It is advantageous when a second segment comprises a polyamide chosen from a group comprising PA-6.10, PA-6.11, PA-6.12. These polyamides have a relatively low water absorption and are less strongly affected when they are exposed to water compared with the PA-group described above. The combination of these two types of material in the core provides an advantageous embodiment of the segments which have a mutually different absorption of water and show a difference in expansion when the layer has worn away and the core is exposed to water.

It is advantageous when the layer comprises a material chosen from a group comprising polyester, polyethylene, polypropylene. These materials absorb practically no water, which makes them suitable for forming the layer which covers the core and which wears during use. These materials thus prevent the segments within the core from coming into contact with water during the pre-determined period of use of the filament and ensure a proper functioning of the filament in the brush during this period.

An embodiment of a filament according to the invention is characterized in that the layer is formed by two layer parts on an outer surface of the core having mutually differing wear resistances, and the core comprises a first and a second segment of the same material which have a mutually different absorption of water and show a difference in expansion when a layer part has worn away and the core is exposed to water. After a certain period of use the first layer part with the lowest resistance to wear will wear first, while the other layer part stays intact. In this manner the layer is worn in an asymmetrical manner along the central axis. A first segment in the core which is present near the first layer part comes into contact with the water first and absorbs the water, which causes this segment to expand. The other segment has not yet been exposed to any water, which causes a difference in expansion between the two segments, which makes the filament bend.

An embodiment of a filament according to the invention is characterized in that the layer and at least one of the segments have mutually different colors. This further enhances the visual indication to the user that the brush should be replaced.

According to the invention, a brush of the type as defined in the opening paragraph is characterized in that the wear-indicating filaments comprise filaments according to the invention. In further embodiments of a brush according to the invention, the brush comprises a brush for a personal care appliance chosen from a group of toothbrushes and cosmetic brushes, or a brush chosen from a group of floor care brushes, paint brushes, and industrial brushes. The wear-indicating filaments according to the invention can be advantageously applied in various kinds of brushes.

The invention will be described in more detail hereinafter with reference to the drawings, in which:

Fig. 1 is a side elevation of a brush with filaments according to a first embodiment of the invention;

Fig. 2 shows a cross-section of a filament taken on the line II-II in Fig. 1;

Fig. 3 shows the filament according to the invention in a bent state;

Fig. 4 shows a cross-section of a second embodiment of a filament according to the invention; and

Fig. 5 shows a cross-section of a third embodiment of a filament according to the invention.

Fig. 1 shows a brush 1 comprising a plurality of wear-indicating filaments 2 according to the invention. Each filament 2 comprises a core 3 which extends along a central axis 5 and which is covered by a layer 4 which has a predetermined resistance to wear. Said layer 4 wears away over a pre-determined period of use dependent on the resistance to wear, and after said period at least a part of the core 3 is exposed. The layer 4 comprises a material which absorbs relatively little water and the core 3 comprises, seen in a cross-section A along the line II-II in Fig. 1, at least two segments 31, 32 in an asymmetrical arrangement along the central axis 5 of the filament 2, as can be seen in Fig. 2. The segments 31, 32 have a mutually different absorption of water and show a difference in expansion when the layer 4 has worn away and the core 3 is exposed to water. Because of the difference in expansion between the segments 31 and 32, the filament 2 bends as shown in Fig. 3. The bent filaments in the brush 1 are a clear indication for the user that the brush has to be replaced for a new one.

In this embodiment, the first segment 31 comprises a polyamide of type PA-6, and the second segment 32 comprises a polyamide of type PA-6.12. PA-6 has a relatively high maximum water absorption of 10% and expands relatively quickly when exposed to water. This material may thus be advantageously used for the first segment in a filament according to the invention. PA-6.12 has a relatively low water absorption and expands less and more slowly when exposed to water compared with the PA-6 type polyamide described above. The combination of these two types of polyamide material in the core provides an advantageous embodiment of the segments. It is noted that other combinations of polyamide or different materials may be used for the segments, as long as the segments 31, 32 are made of materials having a mutually different absorption of water and showing a difference in expansion when the layer 4 has worn away and the core 3 is exposed to water. For example, the segments may alternatively comprise PA-6.6 and PA-6.10 respectively.

In this embodiment, the layer comprises polyester. It is noted that the layer may alternatively comprise polyethylene or polypropylene, or any other known material, as long as it comprises a material which absorbs relatively little water. One of the segments may, for example, be made from the same material as the layer.

Fig. 4 shows a cross-section of a second embodiment of a filament 2' according to the invention, in which the core 3' comprises, seen in a cross-section, three segments 31', 32', 33' in an asymmetrical arrangement along the central axis of the filament, which have a mutually different absorption of water and show a difference in expansion when the layer has worn away and the core is exposed to water. These segments may

alternatively comprise combinations of polyamide or other materials, as long as the segments 31', 32', 33' are made of materials having a mutually different absorption of water and showing a difference in expansion when the layer 4' has worn away and the core 3' is exposed to water. It is noted that also more than three segments may be comprised in the core of a filament according to the invention. In this embodiment, the layer 4' and the segment 31' have mutually different colors. The wearing of the filament is further supported visually by the fading color of the layer 4', and the color of the first segment 31' becoming visible through the worn layer. When the layer has worn away completely and the first segment 31' is visible, this provides an additional indication that the brush should be replaced, next to the bending of the filament caused by the segment materials having a mutually different absorption of water and showing a difference in expansion when the layer 4' has worn away and the core 3' is exposed to water.

Fig. 5 shows a cross-section of a third embodiment of a filament 2" according to the invention, in which the layer 4" is formed by two layer parts 41, 42 on an outer surface 43 of the core 3" having mutually differing wear resistances, and the core 3" comprises a first and a second segment 31", 32" of the same material, which segments have a mutually different absorption of water and show a difference in expansion when a layer part 41 has worn away and the core is exposed to water. In this embodiment, the first layer part 41 has the lowest resistance to wear, which resistance is chosen so as to expire at the end of the period in which the brush can be used without hygienic risk. When this preferred period of use has ended, the first layer part 41 has worn away and the first segment 31" of the core 3", which is present directly beneath the first layer part 41, gets exposed to water. This segment 31" absorbs the water more quickly and thus expands more quickly than the second segment 32", which causes the filament 2" to bend.

It is observed that the brush 1 may be a brush for a personal care appliance such as an electrical toothbrush, or a facial cleaning device. The brush may alternatively be a brush chosen from a group of floor care brushes, paintbrushes, and industrial brushes.